

AD-A157 464 VALIDATION OF THE ALGORITHM FOR DEPOT TC TO OTHER COSTS  
FOR THE COMPONENT. (U) INFORMATION SPECTRUM INC  
ARLINGTON VA S J EINHORN 12 APR 84 ISI-V-83-31859-14  
UNCLASSIFIED F33600-82-C-0543 F/G 5/1

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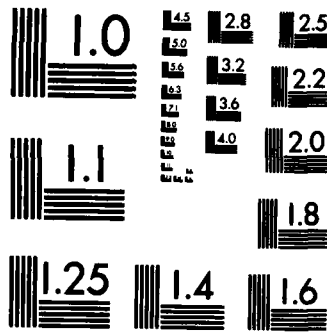
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AD-A157 464

VALIDATION OF THE ALGORITHM FOR  
DEPOT TCTO OTHER COSTS  
FOR  
THE COMPONENT SUPPORT COST SYSTEM  
(D160B)

Contract No. F33600-82-C-0543

12 April 1984

Report Number  
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Submitted to:

Prepared by:

HEADQUARTERS  
AIR FORCE LOGISTICS COMMAND  
MM(VAMOSC)  
WRIGHT-PATTERSON AFB, OH 45433

*Sheldon J. Einhorn*  
Dr. Sheldon J. Einhorn

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## EXECUTIVE SUMMARY

Visibility and Management of Operating and Support Costs is a program initiated by the Office of the Secretary of Defense (OSD) in order to ensure that each Military Department gathers, tracks, and computes operating and support costs by weapon system. VAMOSC II is an Air Force management information system which is responsive to the OSD initiative. It uses information from existing Air Force systems to satisfy both Air Force and OSD needs for certain weapon system operating and support (O&S) costs.

At present, the VAMOSC II system comprises three subsystems:

- (1) The Weapon System Support Cost (WSSC) system (D160), which deals with aircraft,
- (2) The Communications - Electronics (C-E) system (D160A), which deals with ground communications - electronics equipment,
- (3) The Component Support Cost Subsystem (CSCS) (D160B), which deals with subsystems and components for aircraft.

The Component Support Cost System (CSCS) of VAMOSC II gathers and computes support costs by assembly/subassembly and relates those costs back to the end item or weapon system. CSCS replaces the Logistic Support Cost (LSC) model of K051 (AFLCR 400-49) for aircraft and engines.

The CSCS receives inputs from 15 Air Force data systems. On a quarterly basis, the system provides two standard reports each processing cycle and twelve other types of reports as requested by users. It also provides pre-programmed data base extracts on

magnetic tape on a one-time basis in response to user requests. Special requests for data in user selected format may also be satisfied on a case by case basis.

At the heart of the CSCS is a set of 30 algorithms for estimation or allocation of costs. Information Spectrum, Inc. (ISI) was awarded a contract to validate these algorithms. This effort included investigations of logic, appropriateness of the algorithms and assumptions inherent in the algorithms. ISI was also to survey published findings, reports of audit, etc. relating to the accuracy to the source data systems. In addition to the algorithm validation, ISI was to perform certain "special tasks," including a user survey.

This report provides the verification and validation of an algorithm called "Depot TCTO Other Costs." The cost of direct labor performed in maintenance of aircraft is a major component of support costs. This maintenance includes activities in response to Time Compliance Technical Orders (TCTOS), which are "directives issued to provide instructions to Air Force activities for accomplishing 'one-time' changes, modifications, or inspections of equipment or installation of new equipment. "Other" costs include all depot costs other than direct labor or direct materials, which were addressed in earlier reports. These costs at the depot level are provided separately for each combination of aircraft MDS and depot.

Some TCTO actions are identified as modifications. Existing Air Force data systems identify depot "other" costs for modifications directly, and the CSCS uses these values.

For depot TCTO actions which are not modifications, the method is a little less direct. Total TCTO manhours and modification TCTO manhours at the depot level are available. Their difference, representing non-modification TCTO manhours, is multiplied by an average "other" cost rate representative of the depot and aircraft MDS of interest, yielding an estimated "other" cost for depot TCTO actions other than modifications.

In order to verify and validate the CSCS algorithms, a set of analysis procedures applicable to all of the algorithms was established. These procedures were then applied to each algorithm. This report first describes the analysis procedures, without reference to the specific algorithm addressed by this report.

Next, the Depot TCTO Other Cost algorithm is defined and described in detail. This description includes identification of source data systems and files, and the calculation procedures currently implemented by the CSCS.

Finally, a critique of the algorithm is provided as required by the contract. It addresses the following topics:

- o Verification of assumptions and approximations for appropriateness and accuracy.
- o Validation of accuracy of source data.
- o Validation of appropriateness of source data as inputs to CSCS logic.
- o Investigation of accuracy and appropriateness of algorithms.
- o Consideration of replacement of indirect cost methods with more direct ones.

- o Identification of algorithm impact on CSCS output reports.

For each algorithm addressed, ISI is required to affirm the process or procedure and reject any portion that cannot be affirmed. Where the algorithm or portion of the algorithm is rejected, an alternate procedure must be specified.

For the Depot TCTO Other Cost algorithm, all aspects are affirmed. It is recommended that the algorithm be retained in its present form.

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## TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION .....	1
1.1 The Component Support Cost System .....	1
1.2 Overview of the Algorithm .....	3
2.0 ANALYSIS PROCEDURES .....	7
2.1 Algorithm Description .....	7
2.2 Input Data Definitions .....	7
2.3 Concept Validation .....	8
2.4 Problem Resolution .....	11
2.5 Documentation .....	11
3.0 ALGORITHM ANALYSIS .....	12
3.1 Algorithm Description .....	12
3.1.1 Calculations .....	13
3.1.2 Inputs .....	13
3.1.3 Description of Calculation Procedure .....	15
3.2 Critique of Algorithm .....	19
3.2.1 Appropriateness and Accuracy of Assumptions and Approximations .....	19
3.2.2 Accuracy of Source Data and Congruence of Data Element Definitions .....	20
3.2.3 Appropriateness of Source Data as Inputs .....	21
3.2.4 Accuracy and Appropriateness of Algorithm .....	21
3.2.5 Directness of Costing .....	22
3.2.6 Application to CSCS Output Reports .....	22
4.0 RECOMMENDATIONS .....	24
4.0a Office of VAMOSC (OOV) Comments .....	24
REFERENCES .....	25
APPENDIX A - WORK PERFORMANCE CATEGORIES AND WORK BREAKDOWN STRUCTURE CODES	



LIST OF TABLES

<u>Number</u>		<u>Page</u>
1	CSCS OUTPUT REPORTS .....	4
2	CSCS ALGORITHM NAMES .....	5
3	H036B COST AND LABOR HOUR DATA ELEMENTS .....	16
4	CONTRIBUTION OF DEPOT TCTO LABOR COST ALGORITHM TO CSCS OUTPUT REPORTS .....	23

## 1.0 INTRODUCTION

Visibility and Management of Operating and Support Costs is a program initiated by the Office of the Secretary of Defense (OSD) in order to ensure that each Military Department gathers, tracks, and computes operating and support costs by weapon system (all costs are computed and portrayed in "then year" dollars). VAMOSC II is an Air Force management information system which is responsive to the OSD initiative. It uses information from existing Air Force systems to satisfy both Air Force and OSD needs for certain weapon system operating and support (O&S) costs.

At present, the VAMOSC II system comprises three subsystems:

- (1) The Weapon System Support Cost (WSSC) system (D160), which deals with aircraft,
- (2) The Communications - Electronics - (C-E) system (D160A), which deals with ground communications - electronics equipment,
- (3) The Component Support Cost Subsystem (CSCS) (D160B) which deals with subsystems and components for aircraft.

### 1.1 The Component Support Cost System

The Component Support Cost System (CSCS) of VAMOSC II gathers and computes support costs by assembly/subassembly and relates those costs back to the end item or weapon system. CSCS replaces the Logistic Support Cost (LSC) model of K051 (AFLCR 400-49) for aircraft and engines.

The objectives of the Component Support Cost System are:

- (1) To improve the visibility of aircraft and engine component support costs and to relate those costs to the end item or weapon system.
- (2) To improve the Life Cycle Costing capability for the Air Force and the Department of Defense in the acquisition of new weapon systems.
- (3) To assist in the design of new weapon systems by providing cost information on existing weapon systems, thereby enhancing design tradeoff studies.
- (4) To provide historical cost information at the weapon system level to improve logistic policy decisions.
- (5) To identify system component reliability, effectiveness, and costs so that high support cost items may be identified and addressed.

The CSCS is described in detail in references [1], [2], and [3]. It receives inputs from 15 Air Force data systems. On a quarterly basis, the system provides two mandatory reports each processing cycle and twelve other types of reports as requested by users. It also provides pre-programmed data base extracts on magnetic tape on a one-time basis in response to user requests. Special requests for data in user selected format may also be satisfied on a case by case basis.

The twelve reports mentioned above are of primary interest to the user community. They are identified by name in Table 1. Descriptions and samples are provided by reference [1].

At the heart of the CSCS is a set of 30 algorithms for estimation or allocation of costs. The algorithms are identified by name in Table 2. Information Spectrum, Inc. (ISI) was awarded a contract to validate these algorithms. This effort includes investigations of logic, appropriateness of the algorithms, and assumptions inherent in the algorithms. ISI was also to survey published findings, reports of audit, etc. relating to the accuracy of the source data systems. In addition to the algorithm validation, ISI was to perform certain "special tasks," including a user survey.

## 1.2 Overview of the Algorithm

This report provides the verification and validation of algorithm 20 of Table 2, "Depot TCTO Other Costs." Time Compliance Technical Orders (TCTOs) are identified in reference [32] as the media to provide instructions to Air Force activities for accomplishing or making a record of "one time" changes to standard systems, equipment, materials, munitions, and computer programs or for imparting precautionary instructions relating to safety, limitations, or inspections or system/equipment or munitions. Compliance is required within specified time limits.

The totality of depot costs may be categorized as labor, material, and other. "Other" includes overhead, general and administrative, and similar costs. The CSCS calculation of depot TCTO labor costs was discussed in reference [33], and depot TCTO

TABLE 1. CSCS OUTPUT REPORTS

<u>Number*</u>	<u>Name</u>
8105	Cost Factors
8104	MDS Logistics Support Costs
8106	Base Work Unit Code (WUC) Costs
8107	Total Base Work Unit Code (WUC) Costs
8111	Depot On-Equipment Work Unit Code (WUC) Costs
8108	Total Base and Depot Work Unit Code (WUC) Costs
8109	NSN-MDS-WUC Cross-Reference
8110	MDS-WUC-NSN Cross-Reference
8112	Logistic Support Cost Ranking, Selected Items
8113	Summary of Cost Elements
8114	NSN-WUC Logistics Support Costs
8115	Assembly-Subassembly WUC Costs

\* CSCS output reports are assigned Report Control symbol HAF-LEY(AR)nnnn, where nnnn is the number in the table.

TABLE 2. CSCS ALGORITHM NAMES

1. Base TCTO Labor Cost
2. Base TCTO Overhead Cost
3. Base TCTO Material Cost
4. TCTO Transportation Costs
5. Base Inspection Costs
6. Base Other Support General Costs
7. Base Labor Costs
8. Base Direct Material Costs
9. Base Maintenance Overhead Costs
10. Second Destination Transportation Costs
11. Second Destination Transportation Costs (Engine)
12. Base Exchangeable Repair Costs (NSN)
13. Base Exchangeable Repair Costs (Engine)
14. Base Exchangeable Modification Costs (NSN)
15. Base Condemnation Spares Costs/NSN
16. Base Exchangeable Modification Costs (Engine)
17. Base Supply Management Overhead Costs
18. Depot TCTO Labor Costs
19. Depot TCTO Material Costs
20. Depot TCTO Other Costs
21. Depot Support General Costs
22. Depot Labor Costs
23. Depot Direct Material Costs
24. Depot Other Costs
25. Depot Exchangeable Repair Costs (NSN)
26. Depot Exchangeable Repair Costs (Engine)
27. Depot Exchangeable Modification Costs (NSN)
28. Depot Exchangeable Modification Costs (Engine)
29. Depot Condemnation Spares Costs (NSN)
30. Depot Material Management Overhead Cost

material costs in reference [34]. The algorithm addressed in this report calculates the depot TCTO "other" costs for a calendar quarter, separately for each combination of aircraft MDS and depot. This algorithm is very similar to the algorithm for depot TCTO labor costs.

## 2.0 ANALYSIS PROCEDURES

In order to verify and validate the CSCS algorithms, a set of analysis procedures applicable to all of the algorithms was established. These procedures were then applied to each algorithm. This section describes the analysis procedures, without reference to the specific algorithms addressed by this report.

The algorithm analysis process consists of five portions, described in the following sections.

### 2.1 Algorithm Description

The algorithms are described in references [1], [2], and [3]. These descriptions are not identical. In general they supplement, rather than contradict each other. The first two describe what the system is to achieve; the third describes the system design to do so.

None of these descriptions provides the combination of level of detail and clarity of concept required for this validation effort. The first step in the analysis methodology was the generation of such a description. The descriptions in the three reference sources just cited were made explicit. When necessary, Air Force personnel involved in implementation of the D160B subsystem were contacted for clarification.

### 2.2 Input Data Definitions

Closely related to the first step was the clarification of the definitions of the input data. The identification of each



input data element and of the system providing it was provided by the User's Manual (reference [1]). This identification was refined by identification of a particular file within the source system and the structure of the file as described in both the CSCS System/Subsystem Specification and in the Memoranda of Agreement. The Memoranda of Agreement have been established between the Office of VAMOSC and the Offices of Primary Responsibility (OPR) for the systems providing the input data. Any inconsistencies or voids were identified and resolved through contact with the Office of VAMOSC and/or implementing personnel.

Whenever appropriate, input data element definitions were further refined by tracing the elements back to their sources through the reference data provided. If these were inadequate, the OPRs were contacted directly for clarifications. In tracing the data back to their origins, possible sources of data contamination were considered. Information on the likelihood and significance of such contamination was collected from cognizant personnel and from published references.

### 2.3 Concept Validation

The two steps above established exactly what the algorithm does. The third, and most critical step, considered the validity of the procedure. It depends on the ability of the analyst to translate mathematical formulas and data processing techniques into meaningful concepts.

Some explicit techniques which were generally used in concept validation are listed below.

- (a) Consider how the cost element would be calculated if there were no constraints on resources. (For example, suppose the CSCS could identify the pay grade and hours worked of each individual involved in a maintenance action.)
- (b) Identify assumptions\* incorporated into the Algorithm. Generally this procedure will identify the real constraints which affect the approach in (a) above.
- (c) Identify approximations incorporated into the algorithm. For instance, one such approximation is the use of an average labor rate for each aircraft.
- (d) Study each approximation for possible sources of error. Some examples are biases introduced by editing procedures, obsolete data, or inappropriate application. Whenever feasible, estimate the likelihood of these errors by reviews of the literature and contact with cognizant personnel.
- (e) Test the algorithms under conditions of assumed extreme values for the inputs. For instance, in evaluating the algorithm for base maintenance overhead costs, assume

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\* Note that assumptions, approximations, and allocations are different concepts, although in some cases the boundaries between them are not sharp. ISI has recognized few assumptions in the algorithms, but many approximations and allocations.

that for a single reporting period all maintenance labor is overhead and none is direct. Also try the reverse assumption. If an assumption of an extreme input leads to an illogical result, the algorithm is flawed.

Task 4 of Section C-2, c of the contract speaks of appropriate statistical techniques to confirm or repudiate each algorithm. Statistical techniques could confirm or repudiate only statistical hypotheses as assumptions. (Use of an average does not constitute an assumption.) Accordingly, statistical techniques apply to confirmation or repudiation of an algorithm only to the extent that statistical hypotheses can be developed.

- (f) As each algorithm is considered, ensure that the costs do not overlap others already accounted for. (In some cases an overlap may be necessary and desirable. Where this occurs, the overlap will be noted.)
- (g) In each CSCS output report, identify the data elements incorporating the output of the algorithm, so that a final assessment of report accuracy can be made for each output report.
- (h) Consider alternative sources of input data for the algorithm. Also consider more direct cost assignments than those incorporated in the algorithm.

#### 2.4 Problem Resolution

Whenever a significant deficiency was recognized in one of the algorithms, one or more proposed solutions were developed. This was a creative analytic process for which few guidelines could be proposed in advance. Certainly it depended on familiarity with the various existing Air Force data reporting and processing systems. Proposed solutions were discussed with personnel of the Office of VAMOSC, and revised as appropriate. Recommended solutions were expressed in the form of contributions to a draft Data Automation Requirement (DAR) when these would be applicable.

#### 2.5 Documentation

The documentation of the analysis of each algorithm was a crucial part of the effort. Emphasis was placed on making it thorough, clear, and unambiguous. In the documentation, every assertion was substantiated. This was done by reference to source documentation, by explicitly expressed application of the experience and judgment of the contractor, or by citation of information provided by cognizant Air Force personnel. In the last case, the information was supported by documentation identifying the source, the date, and the information provided.

### 3.0 ALGORITHM ANALYSIS

The previous section described the general analysis procedures applied to all algorithms. This section presents the results of applying those procedures to the algorithm for Depot TCTO Other Costs.

Section 3.1 provides a detailed description of the algorithm and of the input data it uses. Section 3.2 provides a critique, structured to correspond to the contractual requirements. Section 4.0 makes recommendations for solutions of problems.

#### 3.1 Algorithm Description

In the following description COBOL-type data names are used to express the algorithm outputs and their components. The available source documentation does not provide the actual data names used by the CSCS programs. They are presumably different from those used in this report.

There are three kinds of TCTO actions: Class IV modifications, Class V modifications, and "other." The three kinds are explained in Section 3.1.3 below. Although the User's Manual identifies a single algorithm as "Depot TCTO Other Costs," in fact the CSCS calculates and presents "other" costs separately for the three cases.

The calculation formulas are stated in Section 3.1.1. The input data elements and their sources are provided in Section 3.1.2. The calculation is described verbally in Section 3.1.3. Unless otherwise noted, the descriptions are based on references [1], [2], and [3], and on direct discussion with personnel of the Office of

VAMOSC. In case of any discrepancies, information provided by knowledgeable personnel was accepted as most current, hence most definitive.

### 3.1.1 Calculations

Two kinds of depot TCTO "other" costs are not "calculated," they are simply aggregated from the input data system. These two, identified here as CLS-IV-OTHER and CLS-V-OTHER, are aggregated as described in Sections 3.1.2 and 3.1.3. It is convenient to express the remaining calculations by three formulas:

(1) DEPOT-MDS-OTHER-RATE

$$= \frac{\text{DEPOT-NONMOD-OTHER-COST}}{\text{CIV-PROD-MH} + \text{MIL-PROD-MH}}$$

(2) DEPOT-TCTO-OTHER-MH

$$= \text{DEPOT-TCTO-MH} - \text{DEPOT-CL-IV-MH} - \text{DEPOT-CL-V-MH}$$

(3) TCTO-NONMOD-OTHER-COST

$$= \text{DEPOT-TCTO-OTHER-MH} \times \text{DEPOT-MDS-OTHER-RATE}$$

### 3.1.2 Inputs

Name: CLS-IV-OTHER

Definition: "Other" cost for Class IV modifications for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

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Name: CLS-V-OTHER

Definition: "Other" cost for Class V modifications for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

Name: DEPOT-NONMOD-OTHER-COST

Definition: Total depot costs, excluding labor and direct material, for depot actions other than modification, for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

---

Name: CIV-PROD-MH

Definition: Civilian direct labor-production<sup>(1)</sup> man-hours, excluding modification actions, for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

---

Name: MIL-PROD-MH

Definition: Military direct labor-production<sup>(1)</sup> man-hours, excluding modification actions, for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

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Name: DEPOT-TCTO-MH

Definition: Total (civilian and military) direct labor man-hours for TCTO for the selected depot, MDS, and calendar quarter.

Source System/File: D056A/MNI75A0

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Name: DEPOT-CL-IV-MH

Definition: Total (civilian and military) direct labor production man-hours for Class IV modifications for the selected depot, MDS and calendar quarter.

Source System/File: H036B/AHMORAL

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Name: DEPOT-CL-V-MH

Definition: Total (civilian and military) direct labor production man-hours for Class V modifications for the selected depot, MDS, and calendar quarter.

Source System/File: H036B/AHMORAL

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<sup>(1)</sup> See discussion in Section 3.1.3.

### 3.1.3 Description of Calculation Procedure

The calculation procedure reflects the structure of the data collected by the H036B data system. That structure is established by reference [29]. Table 3 lists the cost and labor hour data elements collected by the H036B data system. The element numbers are as used in CSCS files, from which this table was extracted.

Each H036B data record identifies a Work Performance Category and a Work Breakdown Structure. The codes for each of these data elements are provided in Appendix A. Only the Work Breakdown Structure Codes for aircraft (first character = "A") are provided.

Reference [12], citing AFLCR 171-24, defines a Class IV modification as "a modification necessary to correct equipment deficiency or installation deficiency that affects maintainability or reliability (flight safety or reliability)." It defines a Class V modification as "a modification required to improve system operational capability (change in mission)." In practice, Air Force personnel agree, Class IV modifications are assigned Work Performance Category code "H", and Class V modifications are assigned code "C." All modifications are classified as either Class IV or Class V.

With the help of the H036B data fields described above, and others, the "other" costs for depot Class IV modifications are aggregated as follows. Records are selected from H036B meeting the following criteria:

- (a) The first character of the Work Breakdown Structure Code is "A," identifying an aircraft.



TABLE 3. H036B COST AND LABOR HOUR DATA ELEMENTS

<u>Number</u> <sup>(1)</sup>	<u>NAME</u>
024	COST, PRODUCTION, DIRECT LABOR, CIVILIAN
025	HOURS, PRODUCTION, DIRECT CIVILIAN LABOR
026	COST, OTHER, DIRECT LABOR, CIVILIAN
027	HOURS, OTHER, DIRECT CIVILIAN LABOR
028	COST, PRODUCTION, DIRECT LABOR, MILITARY
029	HOURS, PRODUCTION, DIRECT MILITARY LABOR
030	COST, OTHER, DIRECT LABOR, MILITARY
031	HOURS, OTHER, DIRECT MILITARY LABOR
032	COST, FUNDED, DIRECT MATERIAL
033	COST, UNFUNDED, DIRECT MATERIAL INVESTMENT
034	COST, UNFUNDED, DIRECT MATERIAL EXCHANGE
035	COST, UNFUNDED, DIRECT MATERIAL, MODIFICATION KITS
036	COST, UNFUNDED, DIRECT MATERIAL EXPENSE
037	COST, FUNDED, OTHER DIRECT
038	COST, UNFUNDED, OTHER DIRECT
039	COST, FUNDED, OPERATIONS OVERHEAD
040	COST, UNFUNDED, OPERATIONS OVERHEAD
041	COST, FUNDED, GENERAL AND ADMINISTRATIVE
042	COST, UNFUNDED, GENERAL AND ADMINISTRATIVE
043	COST, CONTRACT OR INTERSERVICE
044	COST, GOVERNMENT FURNISHED MATERIAL, INVESTMENT
045	COST, GOVERNMENT FURNISHED MATERIAL, EXCHANGE
046	COST, GOVERNMENT FURNISHED MATERIAL, MODIFICATION
047	COST, GOVERNMENT FURNISHED MATERIAL, EXPENSE
048	COST, FUNDED, GOVERNMENT FURNISHED SERVICES
049	COST, UNFUNDED, GOVERNMENT FURNISHED SERVICES
050	COST, FUNDED, MAINTENANCE SUPPORT
051	COST, UNFUNDED, MAINTENANCE SUPPORT

<sup>(1)</sup> As used in CSCS files.

- (b) The third character of the Work Breakdown Structure Code is not "2," eliminating engines.
- (c) The item identification code includes alphabetic characters, thus identifying an entire aircraft, as opposed to a component.
- (d) The Work Performance Category code is "H," identifying a Class IV modification.
- (e) The desired calendar quarter is coded.

For all such records, the costs of elements 37 through 43 and 48 through 51 of Table 3 are summed. These sums are accumulated separately for each combination of depot and MDS. The results are the depot "other" costs for Class IV modifications, CLS-IV-OTHER.

The procedure for accumulating the "other" costs for Class V modifications is exactly the same, except that the Work Performance Category code is "C" instead of "H."

There are aircraft TCTO actions other than modifications. Section 2-5 of reference [32] describes inspection TCTOs, which may involve repair, but which do not change form, fit, or function. The H036B data system does not distinguish such depot activities from non-TCTO actions. Accordingly, the CSCS approach to "other" costs for non-modification TCTO actions is less direct.

First, for each combination of MDS and depot, a depot "other" rate is established, as follows. The total "other" costs for all repair actions other than modifications are accumulated. This is the same process as for modifications, except that the Work

Performance Category codes are A, B, G, I, J, or K.<sup>(1)</sup> The total combined military and civilian production hours are accumulated for the same records. In formula (1) of Section 3.1.1 the costs are divided by the hours, yielding the average depot non-modification "other" cost per production hour, DEPOT-MDS-OTHER-RATE.

The Maintenance Data Collection System (D056) identifies TCTO production man-hours at the depot level. These are accumulated by depot and MDS for the desired quarter. The H036B system identifies production man-hours, military and civilian, identifiable to Class IV and Class V modifications. These, of course, are accumulated by the CSCS programs at the same time it is accumulating the Class IV and Class V modification costs. In formula (2) of Section 3.1.1, the modification production man-hours are subtracted from the total TCTO production man-hours. The result, accumulated separately for each combination of depot and MDS, is the production man-hours for non-modification TCTO actions, DEPOT-TCTO-OTHER-MH.

Finally, in formula (3), these man-hours are multiplied by the average "other" cost rate, yielding for each depot and MDS an estimate of "other" cost for non-modification TCTO actions, TCTO-NONMOD-OTHER-COST.

### 3.2 Critique of Algorithm

This section addresses various facets of the algorithm. The discussion is structured to correspond to the contractual requirements. Each aspect is either affirmed or rejected. Rejections lead to recommendations in Section 4.0.

---

<sup>(1)</sup> See Appendix A.

### 3.2.1 Appropriateness and Accuracy of Assumptions and Approximations

Information Spectrum has identified one approximation used in the Depot TCTO Other Costs algorithm. The approximation is the use of the average (non-modification) depot "other" cost rate in order to estimate non-modification TCTO "other" costs. The average rate is based on depot activities which may include many non-TCTO actions. This approximation implicitly assumes that the actual average "other" rate for non-TCTO activities is the same as the rate for non-modification TCTO activities. Information Spectrum can see no feasible way to verify this assumption, nor any reason to doubt it. Moreover, a future report will show that the algorithm for depot "other" costs for non-TCTO maintenance uses the same approximation, so that the two algorithms taken jointly provide an exact, not approximate, evaluation of "other" costs. Hence we affirm the appropriateness and accuracy of the approximation.

### 3.2.2 Accuracy of Source Data and Congruence of Data Element Definitions

Information Spectrum was directed to validate accuracy of source data based on a survey of published findings, reports of audit, etc. No direct sampling of data was to be performed. The Office of VAMOSC has indicated that direct validation of source data is planned for future efforts.

The source data for this algorithm comes from two data systems. "Other" cost and some labor hour data come from H036B. Other labor hour data comes from D056. No published criticism of the former could be found. Criticisms of D056 have addressed only base

level data collected through the Maintenance Data Collection System, not depot level data. Accordingly, the accuracy of the source data is affirmed.

The definitions of direct labor hours and costs used in H036B derive directly from Section 32004 of reference [29]. That reference establishes "direct labor-production" and "direct labor-other" as encompassing all direct labor costs. It also defines direct labor-production as "those production operations which are performed in sequence and normally have established time standards ... Included are operators of heat treating, plating, and painting equipment; excluded are material handlers who deliver and preposition repair parts and supplies for subsequent use." This corresponds to D056 labor, commonly referred to as "hands-on" or "wrench turning" labor as provided by the source systems and as used by the CSCS.

Examination of each entry of Table 3 reveals that the cost elements included in the algorithm are indeed all costs other than direct labor or materials. (Section 350 of reference [29] requires that indirect labor costs be counted as operations overhead or as general and administrative costs.)

Information Spectrum accordingly affirms the congruence of the input definitions as used by the CSCS and as provided by the input data systems.

### 3.2.3 Appropriateness of Source Data as Inputs

In the case of "other" costs for Class IV and Class V modifications, the inputs to the algorithm are the outputs, hence are obviously appropriate. The H036B data system is designed to provide

depot cost data in accordance with the requirements of reference [29], and the inputs are entirely appropriate for developing depot "other" cost rates. Finally, given the approach to development of non-modification TCTO depot "other" costs, the D056 system is an appropriate source for depot labor hours. Thus we affirm the appropriateness of all source data as inputs.

#### 3.2.4 Accuracy and Appropriateness of Algorithm

In developing the "other" costs for modifications, as previously explained, the algorithm aggregates, not calculates, the results. Thus, within the constraints of reporting accuracy, the algorithm is entirely accurate and appropriate.

Since non-modification TCTO "other" costs are not directly reported, it is appropriate to use an approximation. The average depot "other" cost rate developed as described in Section 3.2.1 is considered appropriate by ISI, and accurate. As previously remarked, the sum of TCTO non-modification depot "other" costs and depot MDS non-TCTO "other" costs is necessarily accurate. ISI affirms the accuracy and appropriateness of the algorithm.

#### 3.2.5 Directness of Costing

The depot modification "other" costs are perfectly direct. The "other" costs for non-modification TCTO labor are as direct as appear to be achievable. Hence the directness of costing of the algorithm is affirmed.

#### 3.2.6 Application to CSCS Output Reports

Depot TCTO "other" costs are components of four CSCS reports,

as described by Table 4. The accuracy of the algorithm output will impact the accuracy of the reports as a whole. However, the total report accuracy cannot be addressed until all algorithms are reviewed. This will occur in the final report of this effort. Evaluation of the usefulness of the report will also be provided in the final report of this effort and after ISI conducts a survey of users.

TABLE 4

CONTRIBUTION OF DEPOT TCTO OTHER COST  
ALGORITHM TO CSCS OUTPUT REPORTS

<u>OUTPUT REPORT/NUMBER</u> <sup>(1)</sup>	<u>COST ELEMENTS CONTRIBUTED TO BY THE ALGORITHM</u> <sup>(2)</sup>
1. MDS Logistics Support Cost/8104	1. By MDS for all bases: a. TCTO COSTS (1) OTHER COSTS (a) DEPOT CL IV MODS (b) DEPOT CL V MODS (c) DEPOT OTHER MODS <sup>(3)</sup>
2. Total Base and Depot Work Unit Code (WUC) Costs/8108	2. By MDS: a. TOTAL COSTS, TCTO <sup>(4)</sup>
3. Depot On-Equipment Work Unit Code (WUC) Costs/8111	3. By MDS and ALC: a. DEPOT TOTAL COSTS, TCTO <sup>(4)</sup>
4. Summary of Cost Elements/8113	4. By MDS: a. CLASS IV MODIFICATIONS, DEPOT TCTO COSTS, OTHER <sup>(5)</sup>

<sup>(1)</sup> CSCS output reports are assigned Report Control Symbol HAF-LEY (AR) nnnn, where nnnn is the number in the table.

<sup>(2)</sup> Capital letters indicate the titles printed on the report.

<sup>(3)</sup> Misnomer. Should be Titled "Depot Other".

<sup>(4)</sup> Misnomer. Only modification costs are reported.

<sup>(5)</sup> Misnomer. Should be titled "Depot TCTO Costs, Non-Labor," since the quantity reported is the sum of "other" costs and material costs.



#### 4.0 RECOMMENDATIONS

Section 3 has reviewed the Depot TCTO Other Cost algorithm. All aspects of the algorithm have been affirmed. Information Spectrum recommends that it be retained in its present form.

##### 4.0a Office of VAMOSC (OOV) Comments

Concur.

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MEMORANDA OF AGREEMENT  
FOR SYSTEM INTERFACES

<u>Ref. No.</u>	<u>Memorandum No.</u>	<u>Date</u>
[6.1]	D002A/M024B/D160B-A	9 Jun 1980
[6.2]	D002A/M024B/D160B-B	9 Jun 1980
[6.3]	D024A/D160B-A	30 Jun 1980
[6.4]	D033./ARC/D160B	14 Jun 1980
[6.5]	D042A/DNB/D160B	4 Nov 1983
[6.6]	D046/M024/D160B	9 Apr 1981
[6.7]	D046/D160B	23 Jun 1982
[6.8]	D056A/BDN/D160B-A	23 Jan 1981
[6.9]	D056A/D160B-C	13 Oct 1981
[6.10]	D056A/D160B-D	29 Jan 1981
[6.11]	D056A F005	25 Apr 1979
[6.12]	D056B/BDN/D160B-A	22 Dec 1980
[6.13]	D056C/D160B-A	4 Mar 1981
[6.14]	D071/D160B	17 Jun 1982
[6.15]	D143B/D002A 9159	3 Aug 1979
[6.16]	D143F/ARC/D160B-A	5 Feb 1981
[6.17]	D160/D160B	11 Jun 1982
[6.18]	G004L/M024B/D160B-A	30 May 1980
[6.19]	G004L/M024B/D160B-B	30 May 1980
[6.20]	G004L/M024B/D160B-C	5 Nov 1981
[6.21]	G019F/D160B	8 Sep 1982
[6.22]	G033B/D160B	12 Jul 1982
[6.23]	G072D/BDN/D160B-A	19 Apr 1982

MEMORANDA OF AGREEMENT  
FOR SYSTEM INTERFACES (Continued)

<u>Ref. No.</u>	<u>Memorandum No.</u>	<u>Date</u>
[6.24]	H036B/RC/D160B-A	10 Feb 1981
[6.25]	H069R/M024B/D160B-B	19 Jan 1981
[6.26]	O013/BDN/D160B	22 Jul 1982

APPENDIX A

WORK PERFORMANCE CATEGORIES  
AND  
AIRCRAFT WORK BREAKDOWN STRUCTURE CODES

(Extracted from reference [1])



## WORK PERFORMANCE CATEGORIES

**Code A—Overhaul.** The disassembly, test, and inspection of the operating components and the basic structure to determine and accomplish the necessary repair, rebuild, replacement and servicing required to obtain the desired performance. It is considered to be synonymous with the terms "rework" or "rebuild."

**Code B—Progressive Maintenance.** A predetermined amount of work that presents a partial overhaul under a program that permits the complete overhaul to be accomplished during two or more time periods. It is considered synonymous with the terms "cycle maintenance," "restricted availability," "preventive servicing," or "recondition."

**Code C—Conversion.** The alteration of the basic characteristics of an item to such an extent as to change the mission, performance or capability.

**Code D—Activation.** The depreservation, servicing, inspection, test and replacement of assemblies or subassemblies as required to return an item from storage or inactive pool status to operational use.

**Code E—Inactivation.** The servicing and preservation of an item prior to entering storage or an inactive pool.

**Code F—Renovation.** The proof and test evaluation and rework of ammunition or ordnance items as required for retaining their desired capability.

**Code G—Analytical Rework.** The disassembly, test and inspection of end-items, assemblies or subassemblies to determine and accomplish the necessary rework, rebuild, replacement, or modification required. It includes the technical analysis of the findings and determination of maintenance criteria. Includes prototype tear-down, analysis and rework of an item to determine job and material specifications on a future workload.

**Code H—Modification.** The alteration or change of the physical makeup of a weapon/support system, subsystem, component, or part in accordance with approved technical direction.

**Code I—Repair.** Action taken to restore to a serviceable condition an item rendered unserviceable by wear, failure, or damage.

**Code J—Inspection and Test.** The examination and testing required to determine the condition or proper functioning as related to the applicable specifications.

**Code K—Manufacture.** The fabrication of an item by application of labor and/or machines to material.

**Code L—Reclamation.** The authorized processing of

end-items, assemblies or subassemblies to obtain parts or components that are to be retained in the inventory prior to taking disposal action on the remaining items. Covers demilitarization actions on items prior to disposal when the demilitarization is incidental to the reclamation.

**Code M—Storage.** The inspection, represervation and maintenance in a storage status of weapons and equipment items as well as their subsystems and components in the supply system.

**Code N—Technical Assistance.** The use of qualified depot maintenance personnel to provide technical information, instructions, or guidance, or to perform specific work requiring special skills, for operational activities or other maintenance organizations. Includes all demilitarization other than the incidental to reclamation (Code L).

**Code O—Not Used.**

**Code P—Programming and Planning Support.** Includes consolidated long-range workload scheduling and resource utilization; centralized maintenance programming and planning for support of all levels of maintenance; all logistics support exclusive of engineering effort in the programming and development of maintenance support requirements for weapon systems and weapons support activities.

**Code Q—Maintenance Technical and Engineering Support.** Includes the technical and engineering effort in development of maintainability concepts and the maintenance portion of logistics plans dealing with future and present weapons and equipment. Includes regional maintenance representatives, field liaison, maintenance technicians, contract technical services, contract engineering services in direct support of maintenance, contract technicians and engineers in direct support of maintenance.

**Code R—Technical and Engineering Data.** Includes the preparation of technical and engineering data as applied to all categories of equipment. Includes engineering drawings, wiring diagrams, technical orders, engineering technical standards, technical handbooks, technical bulletins and similar publications. Provides for the preparation, editorial review and/or revision of equipment publications pertaining to the operation, repair and repair parts support of DOD materiel. Preparation includes, but is not limited to, the consolidation of source data, drawings and art work, editing, preparation of final printable copy and printing. Includes significant identifiable effort within organic maintenance or at other DOD specialized support functions to produce data in support of maintenance, such as cryptographic or test equipment support data.

**Code S—Technical and Administrative Training.** In-

cludes educational units conducting maintenance training and training associated with new weapon systems or support systems which have been or will be introduced into the DOD inventory. At depot maintenance activities, only training associated with new equipment is maintenance support. This training is separately funded by specific funding documents. Other training accomplished at

depot maintenance activities in support of the depot maintenance operation is not maintenance support, but a part of the depot maintenance operation.

Code T—Nonmaintenance Work. Used to assure completeness of maintenance work force reporting.

### WORK BREAKDOWN STRUCTURE CODE FOR FIRST AND THIRD POSITION

(1)	Position (2)	(3)	Description
A			Aircraft
	1		Fighters
		1	Basic Aircraft (Airframe)
		2	Engine
		3	Aircraft and Engine Accessories and Components
		4	Electronics and Communications Equipment
		5	Armament
		6	Support Equipment
		7	Other
	2		Bombers
		.	Same as for Fighters
	3		Transport
		.	Same as for Fighters
	4		Trainers
		.	Same as for Fighters
	5		Utility
		.	Same as for Fighters

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
		A157464	
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7. AUTHOR(s)  Dr. Sheldon J. Einhorn		6. PERFORMING ORG. REPORT NUMBER V-83-31859-14	
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This study is the fourteenth of a set of reports documenting the findings of a study conducted by Information Spectrum, Inc (ISI) for the Office of VAMOSC, Air Force Logistics Command. This study constitutes an assessment of the algorithm for Depot TCTO Other Costs within the Component Support Cost System (CSCS) subsystem of VAMOSC, the Air Force Visibility and Management of Operating and Support Cost system. CSCS deals with subsystems and components for aircraft.			

20. This report provides the verification of the algorithm called "Depot Time Compliance Technical Order Other Costs." "Other" Costs include all depot costs other than direct labor or direct materials, which were addressed in earlier reports. These costs at the depot level are provided separately for each combination of aircraft and depot.

This volume presents ISIs conclusions and recommendations, and the comments of the Office of VAMOSC.

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